# Space Weather Technical Forecast

Issued on Thursday, 22 August 2024 at 00:17 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

**Space Weather Forecast Headline: R1/R2 flares expected, slight chance of R3 flares, risk reducing slightly. Slight chance of G1/Minor Storms from Days 1-2 (22-23 Aug). Chance of exceeding S1/Minor Radiation Storm.**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Solar activity was Moderate, with two M-class flares recorded in the last 24 hours, the peak being an M5.1 flare from AR3796 at 21/2208UTC.

There are thirteen regions on the visible disc, including three unnumbered regions in the southeast. The largest and most complex regions on the disc are AR3790 and AR3796. AR3790 now centre disc in the south has shown some consolidation and growth in its lead and trailer portions, with a corresponding reduction in intermediate spots in recent hours. AR3796 in the southeast has shown some growth in its leading portion and maintains some magnetic complexity. AR3784 was a large and complex region which has recently rotated over the western limb. The other sunspot regions are comparatively smaller or less complex, and mostly either stable or in slight decay.

A filament lift-off south of AR3793 around 21/1700UTC produced significant darkening on SDO/AIA 211 imagery close to centre disc and may have produced a CME with an Earth directed component. Relevant coronagraph imagery is currently awaited in order to conduct an analysis of this event.

**Solar Wind / Geomagnetic Activity:** The solar wind, as measured by ACE at L1, showed a slow regime. The solar wind speed varied between around 300-350km/s. The density was largely below average. The Interplanetary Magnetic Field was predominately weak, below 8nT, but did rise to close to 9nT towards the end of the period. The north-south component varied weakly but was often southward directed, between +5/-6nT The phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

**Energetic Particles / Solar Radiation:** High energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels.

High energy electron flux (greater than 2MeV) observed at GOES16 was at background levels. The 24-hour fluence was below the Active threshold, with 1.71e6 integrated pfu observed at 22/0000UTC.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** M-class flares are expected with a slight chance of X-flares, however the departure of AR3784 should see a slight dip in daily risks.

**Solar Wind /Geomagnetic Activity:** The geomagnetic forecast is of lower-than-average confidence in detail for this period. A CME occurring around 17/1030UTC has a small chance of giving glancing impacts early on Day 1 (22 Aug). A filament lift-off south of AR3793 around 21/1700UTC is awaiting relevant coronagraph imagery to conduct an analysis.

Some HSS influence from CH60/+ is likely early on Day 1 (22 Aug), perhaps combining with the

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CME from 17 August. A second fast wind from a similarly minor coronal hole (CH61/+) may arrive around 24-36 hours after the onset of CH60/.

Geomagnetic conditions are expected to be largely unsettled to active (Kp3-Kp4) with a chance of G1/minor storm intervals Days 1-2 (22-23 Aug), with potential CME and HSS features. In the absence of any further enhancement conditions are expected to return to predominately quiet levels (Kp0-2) through Day 3 (24 Aug).

**Energetic Particles / Solar Radiation:** High energy proton flux is likely to remain at background levels, with a chance of exceeding the S1/Minor solar radiation storm level should any notable flares occur.

High energy electron flux is expected to remain at background levels. The associated 24-hour fluence is expected to be below the Active level.

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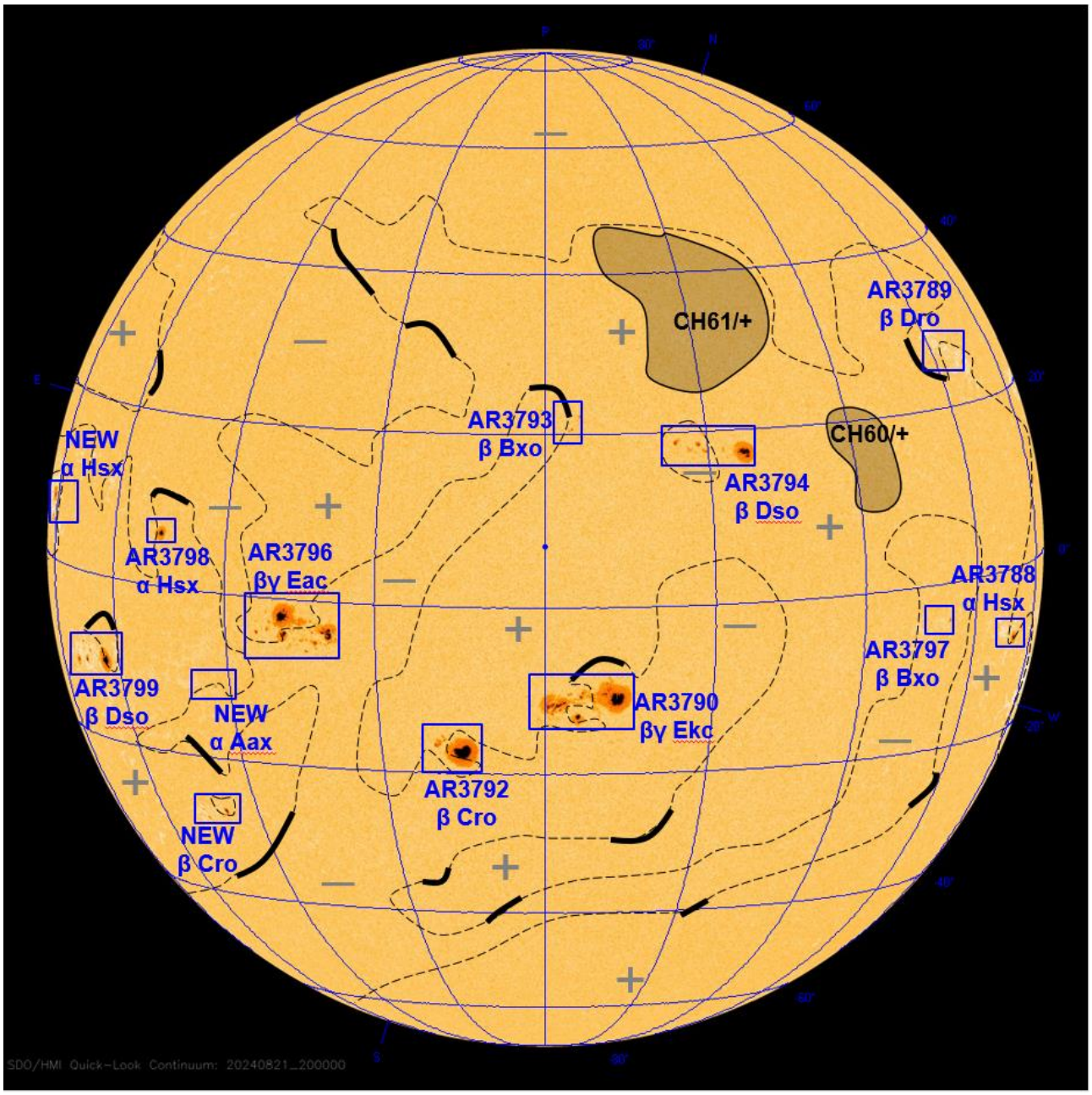
**Figure 1. Solar Analysis Valid 21/2000UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

The geomagnetic forecast is of lower-than-average confidence in detail for this period. The reasons for uncertainty are: the large number of minor transients observed in coronagraph imagery; the marginal nature of a potentially inbound CME; and finally due to the altering shape of the two coronal holes, CH60/+ and CH61/+. There was some potentially High Speed Stream (HSS) related influence on the last rotation, although with an uncertain source at that time as no coronal holes were visible on the disc.

A CME emerged from a broad upper coronal reconfiguration, occurring around 17/1030UTC across a large span of 40N. This resultant CME is most likely to stay above the ecliptic plane, but has a small chance of giving glancing impacts early Day 1(22 Aug) - particularly should it interact with the fast wind from CH60/+.

A filament lift-off south of AR3793 around 21/1700UTC produced significant darkening on SDO/AIA 211 imagery close to centre disc and may have produced a CME with an Earth directed component. Relevant coronagraph imagery is currently awaited in order to conduct an analysis of this event.

Some HSS influence from CH60/+ is likely early on Day 1 (22 Aug), perhaps combining with the CME from 17 August, although with low confidence in the arrival time and peak wind speeds. A second fast wind from a similarly minor coronal hole (CH61/+) may arrive around 24-36 hours after the onset of CH60/+.

Geomagnetic conditions are expected to be largely unsettled to active (Kp3-Kp4) with a chance of G1/minor storm intervals Days 1-2 (22-23 Aug), with potential CME and HSS features. In the absence of any further enhancement conditions are expected to return to predominately quiet levels (Kp0-2) through Day 3 (24 Aug).

| Geo-Magnetic Storm<br>Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 25 | 25 | 20 | 5 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

## Geomagnetic Activity - Earthbound Coronal Mass Ejections

| Date/time 21.5R (UTC) | Halo: Full or Partial | Source | Source Location | Estimated Speed | Estimated Arrival Time | Comments |
|---|---|---|---|---|---|---|
| 17/2001 | Partial | High coronal | 40N across centre disc | 368 km/s | Crosses 1AU 21/1200 UTC | Possible, low confidence, may interact with CH60/+ |

**Figure 2: MOSWOC Enlil and ensemble showing potential CME and HSS features.**

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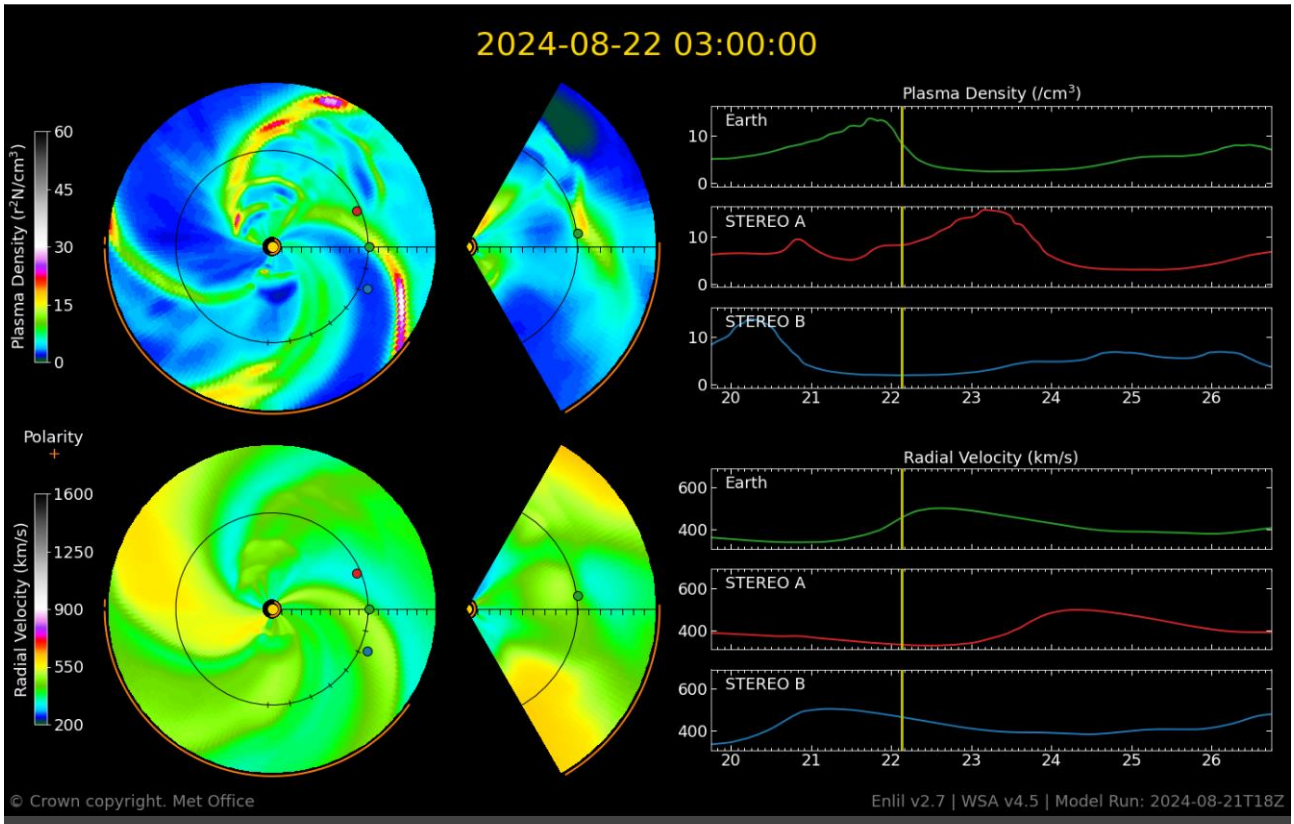


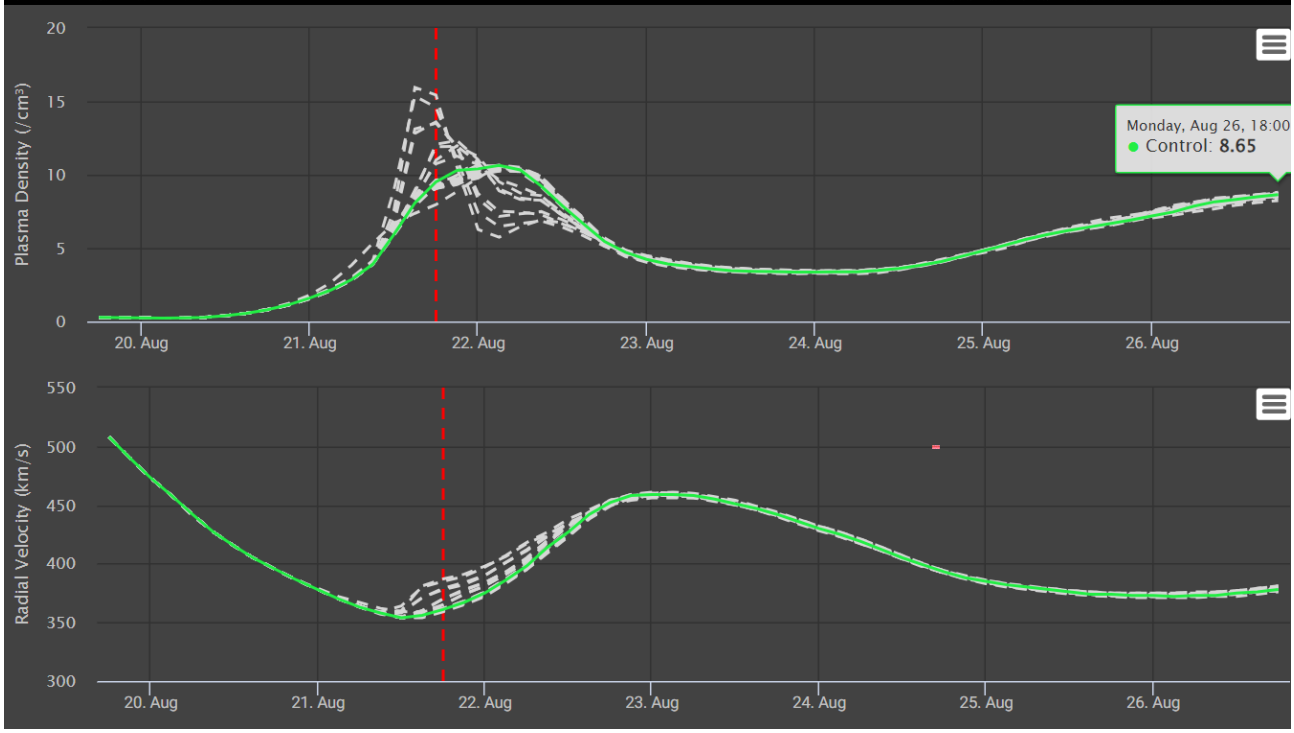


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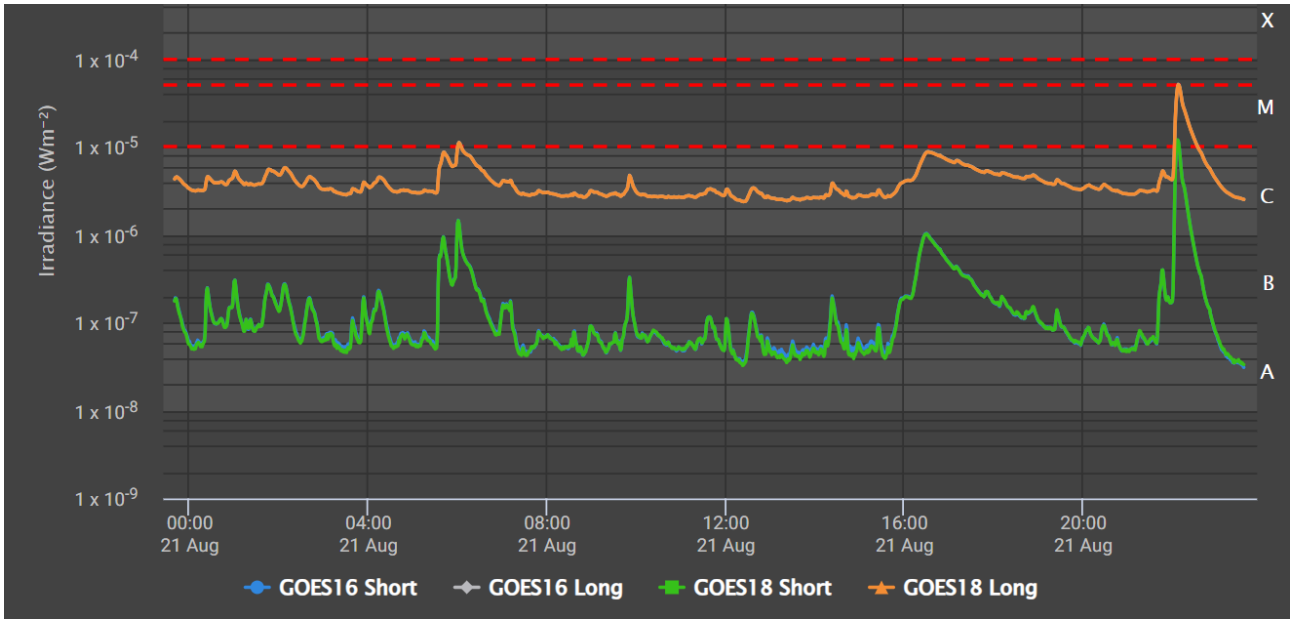
## Radio Blackouts - X-Ray Flares:

There are thirteen regions on the visible disc, including three unnumbered regions in the southeast. The largest and most complex regions on the disc are AR3790 and AR3796. AR3790 now centre disc in the south has shown some consolidation and growth in its lead and trailer portions, with a corresponding reduction in intermediate spots in recent hours. AR3796 in the southeast has shown some growth in its leading portion and maintains some magnetic complexity. AR3784 was a large and complex region which has recently rotated over the western limb. The other sunspot regions are comparatively smaller or less complex, and mostly either stable or in slight decay.

Further M-class flares are anticipated, with a slight chance of isolated X-class flares, mainly originating from AR3784, AR3790, and AR3796. However the trend in X-ray activity should be slightly downward over the four days as AR3784 rotates further around the western limb. Additionally, few new regions are signalled to arrive over the eastern horizon from far-side soundings or returning regions.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | Yes | 75 | 70 | 65 | 60 |
| Very Active | R3 to R5 X Class | No | 20 | 15 | 10 | 10 |

**Figure 3: GOES 16/18 X-RAY trace**

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## Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES18 is likely to persist at background levels, but with a chance of rising in response to any notable flares.

AR3784 just over the western limb is the main region of interest for proton flux risk at present, with this risk slowly reducing once it gets well past the limb later in this period. However, AR3790 is starting to rotate onto the western disc, with a gradually increasing risk of proton events from this feature which will partially balance the reducing risk from AR3784.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | ≥ S1 | No | 20 | 20 | 20 | 20 |
| Very Active | ≥ S3 * | No | 5 | 5 | 5 | 5 |

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

## High Energy Electrons Event (≥ 2MeV):

The high energy electron forecast is of low confidence. Current background electron flux levels are now considered likely to remain that way after recent CME effects, as the solar winds have now returned to background levels. Upcoming potential CME and HSS influence is expected to keep flux levels at background throughout the period.

As such, the fluence is expected to remain below the Active (1e8 integrated pfu) through the rest of this period. MOSWOC REFM is providing reasonable guidance, with relatively flat change in forecast fluence over the coming days.

| GEO Electron Environment Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | ≥ 2 MeV ≥ $1x10^8$ | No | 1 | 1 | 1 | 1 |
| Very Active | ≥ 2 MeV ≥ $1x10^9$ | No | 1 | 1 | 1 | 1 |

**Figure 4: Latest MOSWOC REFM**

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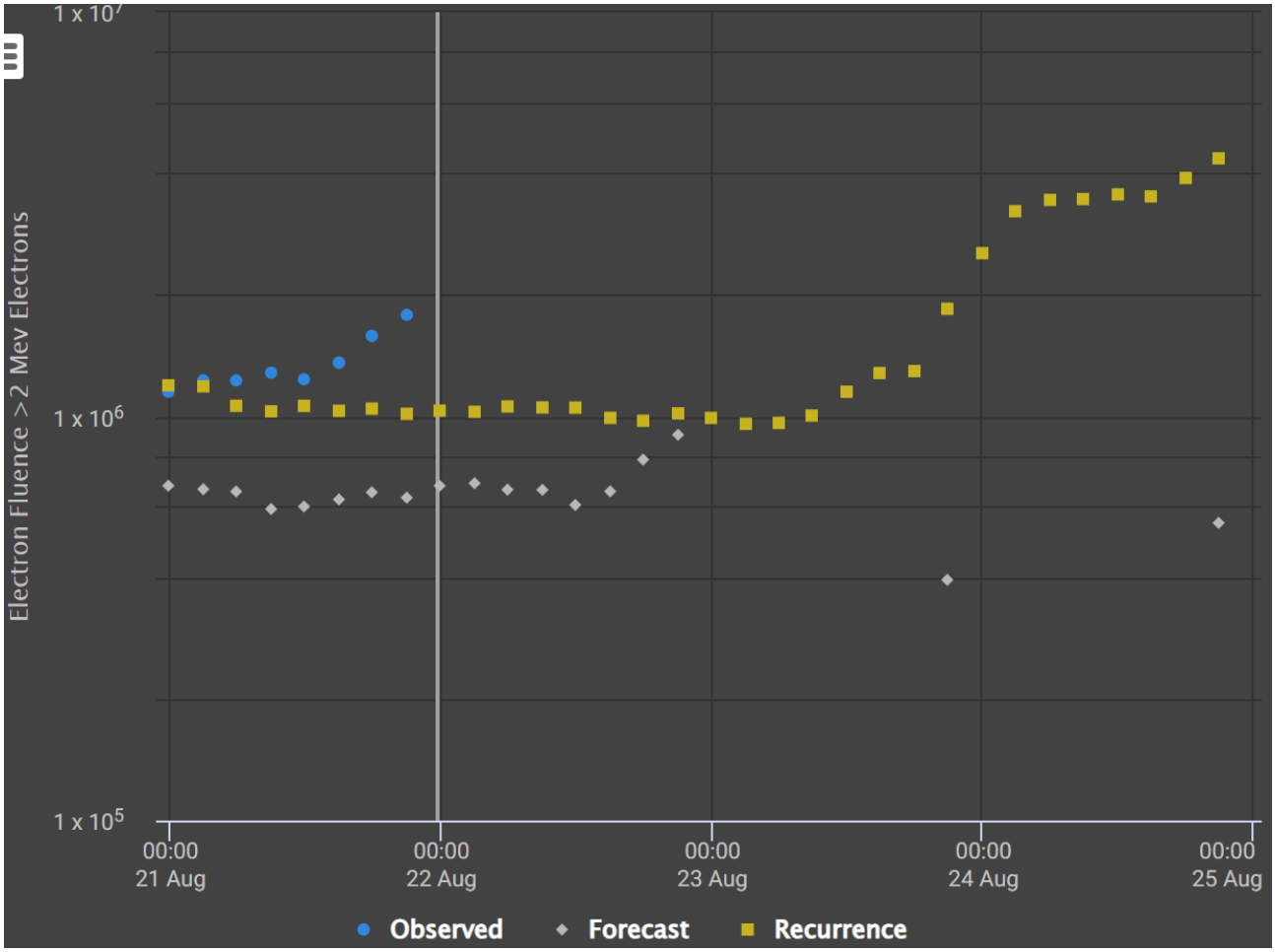


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